I hereby certify that this correspondence (including Exhibits) is being deposited with the United States Postal Service via Express Mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on August 15, 2006 (Express Mail Label No.: ET615079096US).

Natu J. Patel

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of C. Earl Woolfork	
Serial No. 10/648,012	Group Art Unit: 2615
Confirm. No.: 3337	Examiner: Andrew C. Flanders
Filed: August 26, 2003	

For: WIRELESS DIGITAL AUDIO MUSIC SYSTEM

DECLARATION OF APPLICANT REGARDING LIMITED BATTERY LIFE UNDER 35 USC Section 132

I, C. Earl Woolfork, being duly sworn, depose and declare as follows:

1. I am the Inventor of the above referenced patent application ("Application"). I have personal knowledge of the following matter and if asked to testify, could and would testify competently, thereto.

2. Daphne Burton, my then attorney, conducted the interview with Examiner Flanders and Supervisory Patent Examiner Tran (collectively "Examiners") on June 13, 2006 regarding the pending office action dated May 17, 2006. I participated in that interview.

3. During the interview, among other things, we discussed U.S. Patent No. 5,771,441 issued to Altstatt ("Alstatt" or "'the 441 Patent") and U.S. Patent No. 5,946,343 issued to Schotz ("Schotz" or "'the 343 Patent").

4. Examiners requested that I submit evidence in an affidavit under 35 USC Section 132 explaining as to why the combination of Altstatt in view of Schotz is non-operative due to limited battery life.

5. I am hereby submitting this affidavit and all the supporting documentation to the Examiners for their consideration.

6. Altstatt's invention is based on an analog technology and is operated by a battery. Altstatt recites that the maximum value of V is fixed by the battery voltage of 1.5 or possibly 3 volts (Column 8, lines 22-24).

7. Schotz' invention is based on digital technology. Schotz's digital wireless speaker system requires 120VAC at 60Hz. Schotz further states that "[b]oth the transmitter 22 and the receiver 24 have respective power circuits (not shown) that convert input power (e.g., 120VAC at 60 Hz) into proper voltage levels for appropriate transmitter and receiver operation." Please refer to Column 14, lines 1-4.

8. Exhibit A, attached hereto, lists the commercially available Integrated Chip components ("IC Components") that both Altstatt and Schotz identify in their respective designs. Datasheets identifying electrical current requirements to operate the IC Components are included in Exhibit B.

9. Alstatt cannot be combined with Schotz. However, even assuming such a combination is possible, the Altstatt's battery powered analog headphone system will suffer from a significantly reduced playtime due to the power consumption of Schotz's numerous integrated circuit components, as articulated in the calculation spreadsheet attached hereto as Exhibit C.

10. The "playtime" is defined as the time the invention can be operated continuously before the battery must be changed or recharged. The playtime calculation consists of simple unit conversions as defined in chapter one, problem 1.5 and solution set of well known Theodore S. Rappaport's Wireless Communications Principles & Practice textbook. The relevant pages from the textbook are attached herewith as Exhibit D.

According to Exhibit D, the formula for the playtime calculation is:

{((60minutes/1hour) x BmA-h)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)

where B is the battery current capacity.

11. As shown in Exhibit C, Altstatt's portable invention will yield a playtime greater than 10 hours when operated with a small battery having a current capacity of 50mA-h (50 milliamp-hours).

12. If we were to hypothetically apply the same 50mA-h battery capacity to operate Schotz's invention, Exhibit C further shows that the frequency hopping spread spectrum ("FHSS") system will operate for approximately six minutes, and the direct sequence spread spectrum ("DSSS") system will operate for approximately eleven

minutes before requiring a new battery or a recharged battery. Please note that the FHSS and DSSS system operations are constrained to the lowest device (transmitter or receiver) operation time.

Date: 4/14/06

Respectfully Submitted,

By: C. Earl Woolfork

EXHIBIT A

US Patent Number:5,771,441 Issued to Altstatt

Number	Component Description	Reference
1	Transmitter,BA1404	column 5, lines 34-37
2	Receiver,TA7766AF	column 8, lines 54-58
3	Receiver,TA7792F	column 8, lines 54-58

US Patent Number:5,946,343 Issued to Schotz

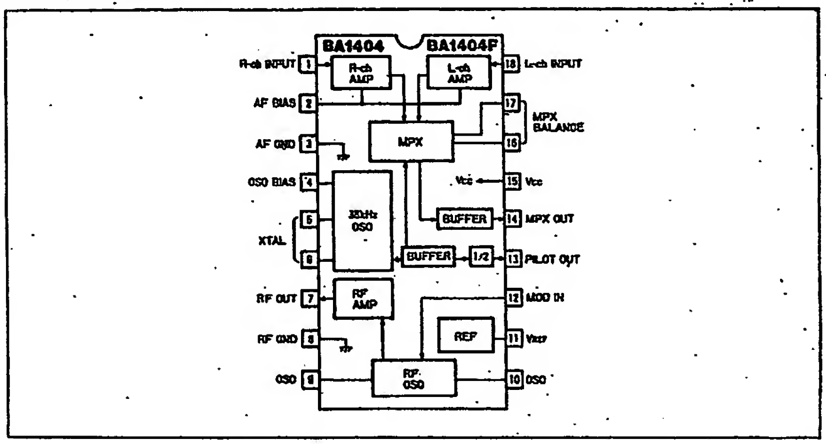
1	Digital Signal Processor,DSP56002	column 14, lines 49-50
2	A/D converter,SAA7360	column 7, lines 11-12
3	Stereo Filter MPEG,SAA2520	column 14, lines 47-48
4	MPEG,SAA2521	column 14, lines 47-48
5	Modulator,RF2422	column 10, lines 17-18
6	Power Amplifier,TQ9132	column 10, lines 31-32
7	Phase Locked Loop,MC12210	column 10, lines 49-50
8	Voltage Controlled Oscillator,SMV2500	column 14, lines 51-53
9	Low Noise Amplifier,MGA86576	column 11, lines 16-18
10	Digital Interface Transmitter,CS8402	column 11, lines 31-33
11	Digital to Analog Converter,TDA1305T	column 13, lines 57-59
12	Clock Recovery & Timing,TRU-050	column 12, lines 28-29
13	Demodulator,RF2703	column 12, lines 13-15
14	Microprocessor,PIC16C55	column 6, lines 63-66
15	DSSS Transmitter,CYLINK SSTX	column 16, lines 62-64
16	DSSS Receiver,CYLINK Part#SPECTRE	column 18, lines 4-5
17	Mixer,IAM81008	column 11, lines 16-18
18	Channel Encoder/Decoder,SRT241203	column 9, lines 25-26
19	Interleaver/De-interleaver,SRT-24INT	column 9, lines 50-52
20	Optical Digital Receiver,HK-3131-01	column 7, lines 40-43
21	Optical Digital Transmitter,HK-3131-03	column 13, lines 15-17
22	Voltage Controlled Oscillator,M2 D300	column 8, lines 49-50

EXHIBIT B

US Patent Number:5,771,441 Issued to Altstatt

Item Number 1: Transmitter, BA1404

● ブロックダイアグラム／Block Diagram T-77-05-05



● 絶対最大定格／Absolute Maximum Ratings (Ta=25℃)

Parameter	Symbol	Limits	Unit
電源電圧	Vcc	2.5	V
許容損失	Pd	600*	mW
動作温度範囲	Topr	−25~75	℃
保存温度範囲	Tstg	−50~125	℃

*Ta=25℃以上で使用する場合は,1℃につき5mWを減じる

● 推奨動作条件／Recommended Operating Conditions (Ta=25℃)

Parameter	Symbol	Min.	Typ.	Max.	Unit
電源電圧	Vcc	1	1.25	2	V

● 電気的特性／Electrical Characteristics (Ta=25℃, Vcc=1.25V)

Parameter	Symbol	Min.	Typ.	Max.	Unit	Conditions
無信号時電流	I_Q	0.5	3	5	mA	—
入力インピーダンス	Z_{IN}	360	540	720	Ω	f_{IN}=1kHz
入力利得	G_V	30	37	—	dB	V_{IN}=0.5mV
チャンネルバランス	CB	—	—	2	dB	V_{IN}=0.5mV
MPX最大出力電圧	V_{OM}	200	—	—	mV_{P-P}	THD≦3%
MPX 38kHzもれ	V_{OO}	—	1	—	mV	無信号時
パイロット出力電圧	V_{OP}	460	580	—	mV_{P-P}	無負荷時
チャンネルセパレーション	Sep	25	45	—	dB	基準復調器にて
入力換算雑音電圧	V_{NIN}	—	1	—	μV_{rms}	38kHz停止時 IHF—A
RF部最大出力電圧	V_{OSO}	350	600	—	mV_{rms}	—

オーディオ用

ELECTRICAL CHARACTERISTICS (Unless otherwise specified, $Ta = 25°C$, $V_{CC} = 1.5V$, $f_m = 1kHz$)

CHARACTERISTIC	SYMBOL	TEST CIRCUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current	I_{CC}	—	At lamp off	—	0.8	1.6	mA
Input Resistance	R_{IN}	—		—	36	—	kΩ
Output Resistance	R_{OUT}	—		—	15	—	kΩ
Max. Composite Signal Input Voltage	$V_{in\ (MAX)}$ (STEREO)	—	L + R = 90%, P = 10%, THD = 5% $SW_1 \rightarrow R_{LED} = 50k\Omega$ $SW_5 \rightarrow$ LPF ON	—	250	—	mV_{rms}
Separation	Sep	—	$L + R = 90mV_{rms}$, $P = 10mV_{rms}$, $SW_1 \rightarrow R_{LED} = 50k\Omega$, $SW_5 \rightarrow$ LPF ON; $f_m = 100Hz$	—	30	—	dB
			$f_m = 1kHz$	22	35	—	dB
			$f_m = 10kHz$	—	30	—	dB
Total Harmonic Distortion — Monaural	THD (MONAURAL)	—	$V_{in} = 100mV_{rms}$ $SW_1 \rightarrow R_{LED} = 500\Omega$	—	0.2	1.5	%
Total Harmonic Distortion — Stereo	THD (STEREO)	—	$L + R = 90mV_{rms}$, $P = 10mV_{rms}$ $SW_1 \rightarrow R_{LED} = 50k\Omega$ $SW_5 \rightarrow$ LPF ON	—	0.4	—	%
Voltage Gain	G_V	—	$V_{in} = 100mV_{rms}$ $SW_1 \rightarrow R_{LED} = 500\Omega$	−4	−2	1	dB
Channel Balance	CB	—	$V_{in} = 100mV_{rms}$ $SW_1 \rightarrow R_{LED} = 500\Omega$	—	0	2.0	dB
Lamp ON Sensitivity	V_L (ON)	—	Pilot input $SW_1 \rightarrow R_{LED} = 50k\Omega$	—	—	5	mV_{rms}
Lamp OFF Sensitivity	V_L (OFF)	—	Pilot input $SW_1 \rightarrow R_{LED} = 500\Omega$	7	—	—	mV_{rms}
Stereo Lamp Hysteresis	V_H	—	to turn-off from turn-on	—	3	—	mV_{rms}
Capture Range	CR	—	$P = 10mV_{rms}$	—	±3	—	%
Carrier Leak (Note) 19kHz	CL	—	$L + R = 90mV_{rms}$ $P = 10mV_{rms}$ $SW_1 \rightarrow R_{LED} = 50k\Omega$	—	30	—	dB
Carrier Leak (Note) 38kHz	CL	—		—	50	—	dB
SCA Rejection Ratio	SCA Rej	—	$P = 10mV_{rms}$, $L + R = 80mV_{rms}$ $SCA = 10mV_{rms}$, $f_{SCA} = 67kHz$ $SW_1 \rightarrow R_{LED} = 50k\Omega$	—	70	—	dB
Signal To Noise Ratio	S / N	—	$V_{in} = 100mV_{rms}$, $R_g = 620\Omega$ $SW_1 \rightarrow R_{LED} = 500\Omega$	—	65	—	dB

(Note) Carrier leak of 38kHz is only carrier.

MAXIMUM RATINGS (Ta = 25°C)

CHARACTERISTIC		SYMBOL	RATING	UNIT
Supply Voltage		V_{CC}	5	V
Power Dissipation	TA7792P	P_D (Note)	750	mW
	TA7792F		350	
Operating Temperature		T_{opr}	−25~75	°C
Storage Temperature		T_{stg}	−55~150	°C

(Note) Derated above Ta = 25°C in the proportion of 6mW / °C for TA7792P, and of 2.8mW / °C for TA7792F.

ELECTRICAL CHARACTERISTICS

Unless otherwise specified, Ta = 25°C, V_{CC} = 1.5V
FM : V_{in} = 60dBμV EMF, f = 83MHz, f_m = 1kHz, Δf = ±22.5kHz
AM : V_{in} = 60dBμV EMF, f = 1MHz, f_m = 1kHz, MOD = 30%

CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION	MIN.	TYP.	MAX.	UNIT
Supply Current		I_{CC} (FM)	1	V_{in} = 0	—	4.0	5.2	mA
		I_{CC} (AM)	1	V_{in} = 0	—	1.2	1.8	
FM	Input Limiting Voltage	$V_{in\ (lim)}$	1	−3dB limiting	—	10	16	dBμV EMF
	Total Harmonic Distortion	THD (FM)	1		—	0.25	—	%
	Signal To Noise Ratio	S / N (FM)	1		—	62	—	dB
	Quiescent Sensitivity	Q_S	1	S / N = 30dB	—	12	—	dBμV EMF
	AM Rejection Ratio	AMR	1	MOD = 30%	—	30	—	dB
	Oscillator Voltage	V_{osc}	2	f = 60MHz	53	90	135	mV_{rms}
	Oscillator Stop Supply Voltage	V_{stop} (FM)	1	V_{in} < −20dBμV EMF	—	0.85	0.95	V
	Recovered Output Voltage	V_{OD} (FM)	1		28	45	68	mV_{rms}
AM	Voltage Gain	G_V	1	V_{in} = 30dBμV EMF	14	25	50	mV_{rms}
	Recovered Output Voltage	V_{OD} (AM)	1		25	40	60	mV_{rms}
	Total Harmonic Distortion	THD (AM)	1		—	1.5	—	%
	Signal To Noise Ratio	S / N (AM)	1		—	40	—	dB
	Oscillator Stop Supply Voltage	V_{stop} (AM)	1	V_{in} < −20dBμV EMF	—	0.85	0.95	V
Output Resistance Pin⑧	FM	R_o (FM)	1	f = 1kHz	—	1.4	—	kΩ
	AM	R_o (AM)	1	f = 1kHz	—	8	—	

※ V_{in} : Open Display

DC ELECTRICAL CHARACTERISTICS

Table 2-3 DC Electrical Characteristics

Characteristics	Symbol	Min	Typ	Max	Units
Supply Voltage	V_{CC}	4.5	5.0	5.5	V
Input High Voltage					
•EXTAL	V_{IHC}	4.0	—	V_{CC}	V
•$\overline{\text{RESET}}$	V_{IHR}	2.5	—	V_{CC}	V
• MODA, MODB, MODC	V_{IHM}	3.5	—	V_{CC}	V
• All other inputs	V_{IH}	2.0	—	V_{CC}	V
Input Low Voltage					
• EXTAL	V_{ILC}	–0.5	—	0.6	V
• MODA, MODB, MODC	V_{ILM}	–0.5	—	2.0	V
• All other inputs	V_{IL}	–0.5	—	0.8	V
Input Leakage Current EXTAL, $\overline{\text{RESET}}$, MODA/$\overline{\text{IRQA}}$, MODB/$\overline{\text{IRQB}}$, MODC/$\overline{\text{NMI}}$, $\overline{\text{DR}}$, $\overline{\text{BR}}$, $\overline{\text{WT}}$, CKP, PINIT, $\overline{\text{MCBG}}$, $\overline{\text{MCBCLR}}$, MCCLK, D20IN	I_{IN}	-1	—	1	µA
Tri-state (Off-state) Input Current (@ 2.4 V/0.4 V)	I_{TSI}	-10	—	10	µA
Output High Voltage (I_{OH} = –0.4 mA)	V_{OH}	2.4	—	—	V
Output Low Voltage (I_{OL} = 3.0 mA) $\overline{\text{HREQ}}$ I_{OL} = 6.7 mA, TXD I_{OL} = 6.7 mA	V_{OL}	—	—	0.4	V
Internal Supply Current at 40 MHz[1]	I_{CCI}	—	90	105	mA
• In Wait mode[2]	I_{CCW}	—	12	20	mA
• In Stop mode[2]	I_{CCS}	—	2	95	µA
Internal Supply Current at 66 MHz[1]	I_{CCI}	—	95	130	mA
• In Wait mode[2]	I_{CCW}	—	15	25	mA
• In Stop mode[2]	I_{CCS}	—	2	95	µA
Internal Supply Current at 80 MHz[1]	I_{CCI}	—	115	160	mA
• In Wait mode[2]	I_{CCW}	—	18	30	mA
• In Stop mode[2]	I_{CCS}	—	2	95	µA
PLL Supply Current[3]					
• 40 MHz		—	1.0	1.5	mA
• 66 MHz		—	1.1	1.5	mA
• 80 MHz		—	1.2	1.8	mA
CKOUT Supply Current[4]					
• 40 MHz		—	14	20	mA
• 66 MHz		—	28	35	mA
• 80 MHz		—	34	42	mA
Input Capacitance[5]	C_{IN}	—	10	—	pF

Notes:
1. **Section 4 Design Considerations** describes how to calculate the external supply current.
2. In order to obtain these results all inputs must be terminated (i.e., not allowed to float).
3. Values are given for PLL enabled.
4. Values are given for CKOUT enabled.
5. Periodically sampled and not 100% tested

Bitstream conversion ADC for digital audio systems

SAA7360

Table 1 Output data formats

ODF2	ODF1	MODE
0	0	test
0	1	format 1
1	0	format 2
1	1	I²S

Reset

When pin $\overline{RESET}$ is held LOW the data outputs are set to zero. The $\overline{RESET}$ pin operates as a Schmitt trigger, enabling a power-on reset function by using an external RC circuit.

LIMITING VALUES

In accordance with the Absolute Maximum Rating System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DDA}	analog supply voltage	note 1	−0.5	+6.5	V
V_I	DC input voltage		−0.5	+6.5	V
I_{IK}	DC input diode current		−	±20	mA
V_O	DC output voltage		−0.5	V_{DD} + 0.5	V
I_O	DC output source or sink current		−	±20	mA
I_{DD} or I_{SS}	total DC V_{DD} or V_{SS} current		−	±0.5	A
T_{amb}	operating ambient temperature		−40	+85	°C
T_{stg}	storage temperature		−65	+150	°C
V_{es}	electrostatic handling	note 2	−2000	+2000	V
		note 3	−200	+200	V

Notes

1. All V_{DD} and V_{SS} pins must be externally connected to the same power supply.
2. Equivalent to discharging a 100 pF capacitor via a 1.5 kΩ series resistor with a rise time of 15 ns.
3. Equivalent to discharging a 200 pF capacitor via a 2.5 µH series inductor.

CHARACTERISTICS

V_{DD} = 5 V; T_{amb} = 25 °C; f_{xtal} = 256f_s; f_s = 44.1 kHz; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supplies						
V_{DDA}	analog supply voltage		4.5	5.0	5.5	V
I_{DDA}	analog supply current		−	43	−	mA
V_{DDD}	digital supply voltage		4.5	5.0	5.5	V
I_{DDD}	digital supply current		−	50	−	mA
P_{tot}	total power consumption		−	465	−	mW

Stereo filter and codec for MPEG layer 1 audio applications SAA2520

LIMITING VALUES

In accordance with the Absolute Maximum System (IEC 134).

SYMBOL	PARAMETER	CONDITIONS	MIN.	MAX.	UNIT
V_{DD}	supply voltage		−0.5	6.5	V
V_I	input voltage	note 1	−0.5	V_{DD} + 0.5	V
I_{SS}	supply current from V_{SS}		–	160	mA
I_{DD}	supply current in V_{DD}		–	160	mA
I_I	input current		−10	10	mA
I_O	output current		−20	20	mA
P_{tot}	total power dissipation		–	880	mW
T_{stg}	storage temperature range		−55	150	°C
T_{amb}	operating ambient temperature range		- 40	85	°C
V_{es1}	electrostatic handling	note 2	−1500	1500	V
V_{es2}	electrostatic handling	note 3	−70	70	V

Notes

1. Input voltage should not exceed 6.5 V unless otherwise specified
2. Equivalent to discharging a 100 pF capacitor through a 1.5 kΩ series resistor
3. Equivalent to discharging a 200 pF capacitor through a 0 Ω series resistor.

DC CHARACTERISTICS

T_{amb} = −40 to 85 °C; V_{DD} = 3.8 to 5.5 V unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DD}	supply voltage range		3.8	5.0	5.5	V
I_{DD}	operating current	V_{DD} = 5 V (note 1)	–	82	110	mA
I_{DD}	operating current	V_{DD} = 3.8 V (note 1)	–	58	80	mA
Inputs URDA, SBDIR, SBEF, LTCLK, LTCNT0, LTNCT1, X22IN, X24IN						
V_{IH}	HIGH level input voltage		0.7V_{DD}	–	–	V
V_{IL}	LOW level input voltage		–	–	0.3V_{DD}	V
$-I_I$	input current	V_I = 0 V; T_{amb} = 25 °C	–	–	10	μA
$+I_I$	input current	V_I = 5.5 V; T_{amb} = 25 °C	–	–	10	μA
Inputs PWRDWN, LTENA						
V_{IH}	HIGH level input voltage		0.7V_{DD}	–	–	V
V_{IL}	LOW level input voltage		–	–	0.3V_{DD}	V
$+I_I$	input current	V_I = V_{DD}; T_{amb} = 25 °C	40	–	250	μA

Masking threshold processor for MPEG layer 1 audio compression applications

SAA2521

DC CHARACTERISTICS

V_{DD} = 3.8 to 5.5 V; T_{amb} = –40 to 85 °C; unless otherwise specified.

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
Supply						
V_{DD}	supply voltage range		3.8	5	5.5	V
I_{DD}	operating current	V_{DD} = 3.8 V	–	15	30	mA
I_{DD}	operating current	V_{DD} = 5 V	–	25	50	mA
I_{PWRDWN}	stand-by current	in power-down mode	–	100	–	µA
Inputs						
V_{IL}	LOW level input voltage		0	–	0.3 V_{DD}	V
V_{IH}	HIGH level input voltage		0.7 V_{DD}	–	V_{DD}	V
I_I	input current		–	–	10	µA
Outputs						
V_{OL}	LOW level output voltage	note 1	–	–	0.4	V
V_{OH}	HIGH level output voltage	note 1	V_{DD} – 0.5	–	–	V
3-state outputs						
I_{OZ}	OFF state current	V_i = 0 to 5.5 V	–	–	10	µA

Note

1. Maximum load current for LTDATA, LTCNT1C, LTCNT0C, LTENC, LTCLKC, TEST1, TEST2, FDAC, FDAF = 2 mA; for LTDATAC = 3 mA.

US Patent Number:5,946,343 Issued to Schotz

Item Number 5: Modulator, RF2422

RF2422

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to +7.5	V_{DC}
Input LO and RF Levels	+10	dBm
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

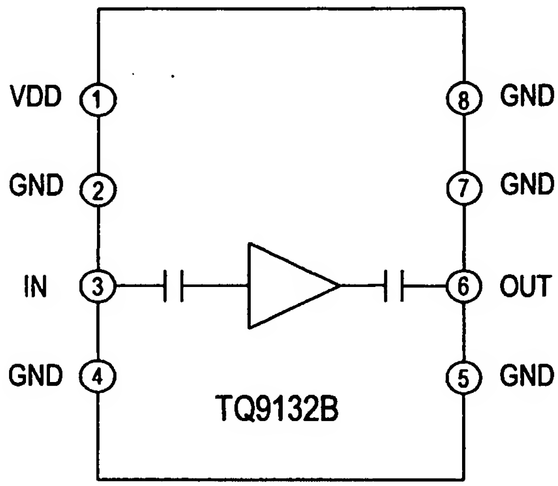
Caution! ESD sensitive device.

Parameter	Specification Min.	Specification Typ.	Specification Max.	Unit	Condition
Carrier Input					T=25°C, V_{CC}=5V
Frequency Range	800		2500	MHz	
Power Level	-6		+6	dBm	
Input VSWR		5:1			At 900MHz
		1.8:1			At 1800MHz
		1.2:1			At 2500MHz
Modulation Input					
Frequency Range	DC		250	MHz	
Reference Voltage (V_{REF})	2.0	3.0		V	
Maximum Modulation (I&Q)			V_{REF}±1.0	V	
Gain Asymmetry		0.2		dB	
Quadrature Phase Error		3		°	
Input Resistance		30		kΩ	
Input Bias Current			40	µA	
RF Output					LO=2GHz and -5dBm, I&Q=2.0V_{PP}, SSB
Output Power	-3		+3	dBm	
Output Impedance		50		Ω	
Output VSWR		3.5:1			At 900MHz
		1.3:1			At 2000MHz
		1.15:1			At 2500MHz
Harmonic Output	-30	-35		dBc	
Sideband Suppression	25	35		dB	
Carrier Suppression	30	35		dB	
IM_3 Suppression	30	35		dB	Intermodulation of the carrier and the desired RF signal
	25	30		dB	Intermodulation of baseband signals
Broadband Noise Floor					At 20MHz offset, V_{CC}=5V. Tied to V_{REF}: ISIG, QSIG, IREF, and QREF.
		-145		dBm/Hz	At 850MHz
		-152		dBm/Hz	At 1900MHz
Power Down					
Turn On/Off Time			100	ns	
PD Input Resistance	50			kΩ	
Power Control "ON"			2.8	V	Threshold voltage
Power Control "OFF"	1.0	1.2		V	Threshold voltage
Power Supply					
Voltage		5		V	Specifications
	4.5		6.0	V	Operating Limits
Current		45	50	mA	Operating
			25	µA	Power Down

US Patent Number:5,946,343 Issued to Schotz

Item Number 6: Power Amplifier, TQ9132

TriQuint SEMICONDUCTOR
WIRELESS COMMUNICATIONS DIVISION



TQ9132B

DATA SHEET

3V Cellular TDMA/AMPS Power Amplifier IC

Features

- *Single 3V- 6V supply*
- *Wide frequency range*
- *+17 dBm output power*
- *Input and output matched to 50 Ω*
- *SO-8 surface mount plastic package*

Applications

- *Power Amplifier drivers*
- *PCN Medium-power amplifiers*
- *Medium-power WLANs*
- *CDPD Modems*
- *Base Station receivers*

Product Description

The TQ9132B amplifier is an 800-2500 MHz amplifier capable of providing moderate output power (50 mW) for a wide variety of transmit and receive applications. The amplifier's input and output are matched to 50 Ω with internal circuitry, simplifying interfaces to 50 Ω systems. In addition, DC blocking capacitors are included on chip, permitting direct connections to the input and output. Its 8-pin surface mount package and low cost are well suited to many wireless communications applications.

Electrical Specifications[1]

Parameter	*Min*	*Typ*	*Max*	*Units*
Gain	13.5	16		dB
Output 1 dB Gain Compression	15.5	17		dBm
Input Return Loss		12		dB
Output Return Loss		12		dB
DC Supply Current		85	100	MA

Note 1: Test Conditions: V_{DD} = 5.0 V, Freq. = 2500 MHz, T_A = 25°C.

Note 2: . Min/max values 100% production tested

US Patent Number:5,946,343 Issued to Schotz

ELECTRICAL CHARACTERISTICS (V_{CC} = 2.7 to 5.5 V; T_A = –40 to +85°C, unless otherwise noted.)

Parameter	Symbol	Min	Typ	Max	Unit	Condition
Supply Current for V_{CC}	I_{CC}	–	8.8	13.0	mA	Note 1
		–	10.2	16.0		Note 2
Supply Current for Vp	Ip	–	0.7	1.1	mA	Note 3
		–	0.8	1.3		Note 4
Operating Frequency f_{IN}max f_{IN}min	F_{IN}	2500 –	– –	– 500	MHz	Note 5
Operating Frequency (OSCin)	F_{OSC}	–	12	20	MHz	Crystal Mode
		–	–	40	MHz	External Reference Mode
Input Sensitivity f_{IN}	V_{IN}	200	–	1000	mVpp	
OSCin	V_{OSC}	500	–	2200	mVpp	
Input HIGH Voltage CLK, DATA, LE, FC	V_{IH}	0.7 V_{CC}	–	–	V	
Input LOW Voltage CLK, DATA, LE, FC	V_{IL}	–	–	0.3 V_{CC}	V	V_{CC} = 5.5 V
Input HIGH Current (DATA and CLK)	I_{IH}	–	1.0	2.0	µA	V_{CC} = 5.5 V
Input LOW Current (DATA and CLK)	I_{IL}	–10	–5.0	–	µA	V_{CC} = 5.5 V
Input Current (OSCin)	I_{OSC}	– –	130 –310	– –	µA	OSCin = V_{CC} OSCin = V_{CC} – 2.2 V
Input HIGH Current (LE and FC)	I_{IH}	–	1.0	2.0	µA	
Input LOW Current (LE and FC)	I_{IL}	–75	–60	–	µA	
Charge Pump Output Current	I_{Source}[6]	–2.6	–2.0	–1.4	mA	V_{Do} = V_p/2; V_p = 2.7 V
Do and BISW	I_{Sink}[6]	+1.4	+2.0	+2.6		V_{BISW} = V_p/2; V_p = 2.7 V
	I_{Hi-Z}	–15	–	+15	nA	0.5 < V_{DO} < V_p – 0.5 0.5 < V_{BISW} < V_p – 0.5
Output HIGH Voltage (LD, ϕR, ϕP, f_{OUT})	V_{OH}	4.4	–	–	V	V_{CC} = 5.0 V
		2.4	–	–	V	V_{CC} = 3.0 V
Output LOW Voltage (LD, ϕR, ϕP, f_{OUT})	V_{OL}	–	–	0.4	V	V_{CC} = 5.0 V
		–	–	0.4	V	V_{CC} = 3.0 V
Output HIGH Current (LD, ϕR, ϕP, f_{OUT})	I_{OH}	–1.0	–	–	mA	
Output LOW Current (LD, ϕR, ϕP, f_{OUT})	I_{OL}	1.0	–	–	mA	

1. V_{CC} = 3.3 V, all outputs open.
2. V_{CC} = 5.5 V, all outputs open.
3. Vp = 3.3 V, all outputs open.
4. V_p = 6.0 V, all outputs open.
5. AC coupling, F_{IN} measured with a 1000 pF capacitor.
6. Source current flows out of the pin and sink current flows into the pin.

Figure 8. Typical External Charge Pump Circuit

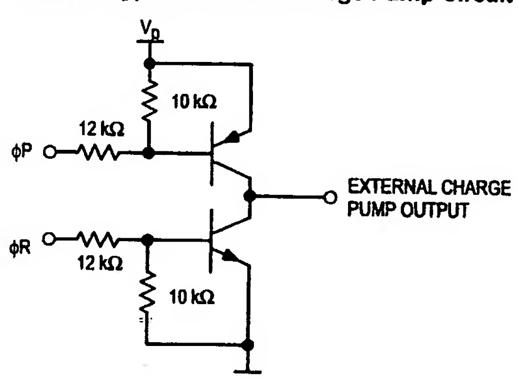
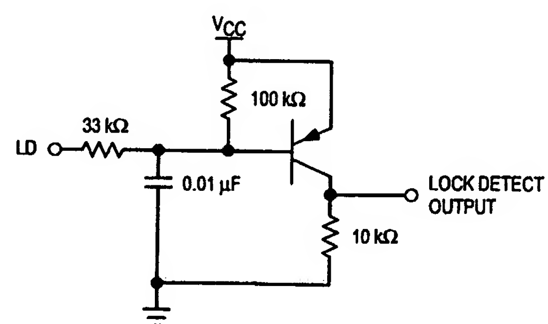


Figure 9. Typical Lock Detect Circuit



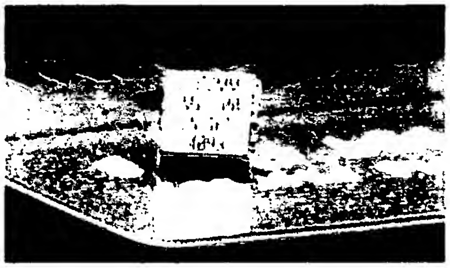
US Patent Number:5,946,343 Issued to Schotz

Item Number 8: Voltage Controlled Oscillator, SMV2500

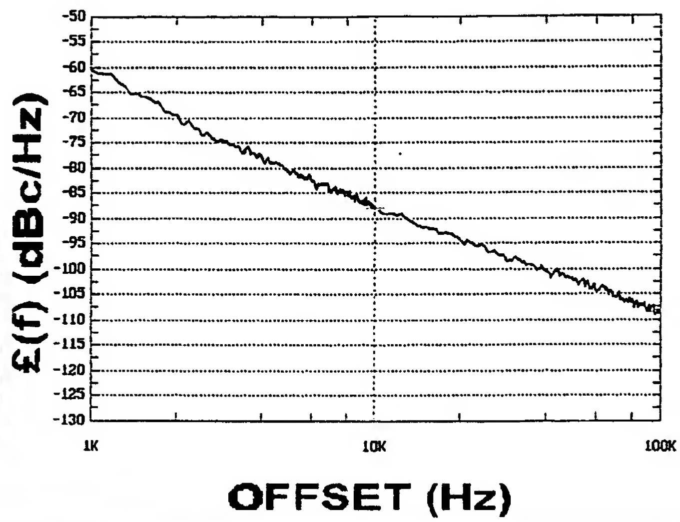
Z-Communications, Inc.
9939 Via Pasar • San Diego, CA 92126
TEL (619) 621-2700 FAX (619) 621-2722

SMV2500L

VOLTAGE CONTROLLED OSCILLATOR
Rev E5



PHASE NOISE (1 Hz BW, typical)



FEATURES
• Frequency Range: 2400 - 2484 MHz
• Tuning Voltage: 0-3 Vdc
• SUB-L - Style Package

APPLICATIONS
• Personal Communications Systems
• WLAN
• Portable Radios

PERFORMANCE SPECIFICATIONS	VALUE	UNITS
Oscillation Frequency Range	2400 - 2484	MHz
Phase Noise @ 10 kHz offset (1 Hz BW, typ.)	-87	dBc/Hz
Harmonic Suppression (2nd, typ.)	-20	dBc
Tuning Voltage	0-3	Vdc
Tuning Sensitivity (avg.)	105	MHz/V
Power Output	9.25±2.75	dBm
Load Impedance	50	Ω
Input Capacitance (max.)	50	pF
Pushing	<30	MHz/V
Pulling (14 dB Return Loss, Any Phase)	<25	MHz
Operating Temperature Range	-40 to 85	°C
Package Style	SUB-L	
POWER SUPPLY REQUIREMENTS		
Supply Voltage (Vcc, nom.)	3	Vdc
Supply Current (Icc, typ.)	19	mA

All specifications are typical unless otherwise noted and subject to change without notice.

APPLICATION NOTES
• AN-100/1 : Mounting and Grounding of VCOs
• AN-102 : Proper Output Loading of VCOs
• AN-107 : How to Solder Z-COMM VCOs

NOTES:

US Patent Number:5,946,343 Issued to Schotz

Item Number 9: Low Noise Amplifier, MBA86576

Absolute Maximum Ratings

Symbol	Parameter	Units	Absolute Maximum[1]
V_d	Device Voltage, RF output to ground	V	9
V_g	Device Voltage, RF input to ground	V	+0.5 -1.0
P_{in}	CW RF Input Power	dBm	+13
T_{ch}	Channel Temperature	°C	150
T_{STG}	Storage Temperature	°C	-65 to 150

Thermal Resistance[2]:
$\theta_{ch\text{-}c} = 110°C/W$

Notes:
1. Operation of this device above any one of these limits may cause permanent damage.
2. T_c = 25°C (T_c is defined to be the temperature at the package pins where contact is made to the circuit board).

MGA-86576 Electrical Specifications, T_C = 25°C, Z_o = 50 Ω, V_d = 5 V

Symbol	Parameters and Test Conditions		Units	Min.	Typ.	Max.
Gp	Power Gain ($\|S_{21}\|^2$)	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dB	20	21.2 23.7 23.1 19.3 15.4	
NF_{50}	50 Ω Noise Figure	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dB		2.2 1.9 2.0 2.3 2.5	2.3
NF_o	Optimum Noise Figure (Input tuned for lowest noise figure)	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dB		1.6 1.5 1.6 1.8 2.1	
P_{1dB}	Output Power at 1 dB Gain Compression	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz	dBm		6.4 7.0 6.3 4.3 3.8	
IP_3	Third Order Intercept Point	f = 4.0 GHz	dBm		16.0	
VSWR	Input VSWR	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz			3.6:1 3.3:1 2.2:1 1.4:1 1.2:1	3.6:1
	Output VSWR	f = 1.5 GHz f = 2.5 GHz f = 4.0 GHz f = 6.0 GHz f = 8.0 GHz			2.5:1 2.1:1 1.7:1 1.4:1 1.3:1	
I_d	Device Current		mA	9	16	22

ABSOLUTE MAXIMUM RATINGS (GND = 0V, all voltages with respect to ground.)

Parameter		Symbol	Min	Max	Units
DC Power Supply		VD+		6.0	V
Input Current, Any Pin Except Supply	Note 1	I_{in}	-	±10	mA
Digital Input Voltage		V_{IND}	-0.3	VD+	V
Ambient Operating Temperature (power applied)		T_A	-55	125	°C
Storage Temperature		T_{stg}	-65	150	°C

Notes: 1. Transient currents of up to 100 mA will not cause SCR latch-up.

WARNING: Operation at or beyond these limits may result in permanent damage to the device. Normal operation is not guaranteed at these extremes.

RECOMMENDED OPERATING CONDITIONS

(GND = 0V; all voltages with respect to ground)

Parameter			Symbol	Min	Typ	Max	Units
DC Voltage			VD+	4.5	5.0	5.5	V
Supply Current		Note 2	I_{DD}		1.5	5	mA
Ambient Operating Temperature:	CS8401/2A-CP or -CS	Note 3	T_A	0	25	70	°C
	CS8401/2A-IP or -IS			-40		85	°C
Power Consumption		Note 2	P_D		7.5	25	mW

Notes: 2. Drivers open (unloaded). The majority of power is used in the load connected to the drivers.
3. The '-CP' and '-CS' parts are specified to operate over 0 to 70 °C but are tested at 25 °C only. The '-IP' and '-IS' parts are tested over the full -40 to 85 °C temperature range.

DIGITAL CHARACTERISTICS

(T_A = 25 °C for suffixes 'CP' & 'CS', T_A = -40 to 85 °C for 'IP' & 'IS'; VD+ = 5V ± 10%)

Parameter			Symbol	Min	Typ	Max	Units
High-Level Input Voltage			V_{IH}	2.0		V_{DD}+0.3	V
Low-Level Input Voltage			V_{IL}	-0.3		+0.8	V
High-Level Output Voltage	(I_O = 200µA)		V_{OH}	V_{DD}-1.0			V
Low-Level Output Voltage	(I_O = 3.2mA)		V_{OL}			0.4	V
Input Leakage Current			I_{in}		1.0	10	µA
Master Clock Frequency:	CS8401A	Note 4	MCK			22	MHz
	CS8402A	Note 4				7.1	MHz
Master Clock Duty Cycle	CS8401/2A			40		60	%

Notes: 4. MCK for the CS8401 must be 128, 192, 256, or 384x the input word rate based on M0 and M1 in control register 2. MCK for the CS8402A must be 128x the input word rate, except in Transparent Mode where MCK is 256x the input word rate.

Specifications are subject to change without notice.

Stereo 1fs data input up-sampling filter with bitstream continuous dual DAC (BCC-DAC2)

TDA1305T

QUICK REFERENCE DATA

SYMBOL	PARAMETER	CONDITIONS	MIN.	TYP.	MAX.	UNIT
V_{DDD}	digital supply voltage	note 1	3.4	5.0	5.5	V
V_{DDA}	analog supply voltage	note 1	3.4	5.0	5.5	V
V_{DDO}	operational amplifier supply voltage	note 1	3.4	5.0	5.5	V
I_{DDD}	digital supply current	V_{DDD} = 5 V; at code 00000H	–	30	–	mA
I_{DDA}	analog supply current	V_{DDA} = 5 V; at code 00000H	–	5.5	8	mA
I_{DDO}	operating amplifier supply current	V_{DDO} = 5 V; at code 00000H	–	6.5	9	mA
$V_{FS(rms)}$	full-scale output voltage (RMS value)	$V_{DDD} = V_{DDA} = V_{DDO}$ = 5 V	1.425	1.5	1.575	V
(THD + N)/S	total harmonic distortion plus noise-to-signal ratio	at 0 dB signal level	–	−90	−81	dB
			–	0.003	0.009	%
		at −60 dB signal level	–	−44	−40	dB
			–	0.63	0.1	%
		at −60 dB signal level; A-weighted	–	−46	–	dB
			–	0.5	–	%
S/N	signal-to-noise ratio at bipolar zero	A-weighting; at code 00000H	100	108	–	dB
BR_{ns}	input bit rate at data input	f_s = 48 kHz; normal speed	–	–	3.072	Mbits
BR_{ds}	input bit rate at data input	f_s = 48 kHz; double speed	–	–	6.144	Mbits
f_{sys}	system clock frequency		6.4	–	18.432	MHz
TC_{FS}	full scale temperature coefficient at analog outputs (VOL and VOR)		–	$\pm100 \times 10^{-6}$	–	
T_{amb}	operating ambient temperature		−30	–	+85	°C

Note

1. All V_{DD} and V_{SS} pins must be connected to the same supply.

Item Number 12: Clock Recovery & Timing, TRU-050

Parameter	Symbol	Min	Max	Unit
Input NRZ Data Rates	DATAIN	0.008	65.536	MHz
Input RZ Data and Clock Rates [1]	DATAIN	0.008	32.768	MHz
Nominal Output Frequency				
Output 1	OUT1	12.0	65.536	MHz
Output 2 [2]	OUT2	0.05	32.768	MHz
Supply Voltage [3]	V_{DD}	4.5	5.5	V
Supply Current (V_{DD} = 5.5 V)	I_{DD}	25	63	mA
Output Voltage Levels (V_{DD} = 4.5 V)				
Output Logic High [4]	V_{OH}	2.5	-	V
Output Logic Low [4]	V_{OL}	-	0.5	V
Transition Times: [4]				
Rise Time (0.5 V to 2.5 V)	t_R	0.5	5	ns
Fall Time (2.5 V to 0.5 V)	t_F	0.5	5	ns
Symmetry or Duty cycle [5]				
Output 1	SYM 1	40	60	%
Output 2	SYM 2	45	55	%
Recovered Clock	R_{CLK}	40	60	%
Input Data				
Input Logic High	V_{IH}	2.0	-	V
Input Logic Low	V_{IL}	-	0.8	V
Control Voltage Bandwith (-3 dB, VC = 2.50 V)	BW	50	-	kHz
Sensitivity @ VC = VO	$\Delta F/\Delta V_C$	See Figure 11		ppm/V
Loss of Signal Indication [6]	L_{OS}			
Output Logic High	V_{OH}	2.5	-	V
Output Logic Low	V_{OL}	-	0.5	V
Nominal Output Frequency on Loss of Signal: [7]				
Output 1	OUT1	-75 ppm	75 ppm	ppm from fo 1
Output 2	OUT2	-75 ppm	75 ppm	ppm from fo 2
Phase Detector Gain	K_D	-0.53 x Data Density		V/rad

Table 1.

1. For input RZ data, Manchester encoded data, and input clock recovery applications, the output clock must run at two times the input rate to ensure that the input is clocked correctly. Since the output clock has a maximum frequency of 65.536 MHz, these inputs are limited to a maximum rate of 32.768 MHz.
2. OUT2 is a binary submultiple of OUT1, or it may be disabled.
3. A 3.3 volt supply option is also available.
4. Figure 1 defines these parameters. Figure 2 illustrates the equivalent five-gate MTTL load and operating conditions under which these parameters are specified and tested.
5. Symmetry is the ON TIME/PERIOD in percent with V_S = 1.4 V for TTL, per figure 1.
6. A loss of signal (LOS) indicator is set to a logic high if no transitions are detected at DATAIN after 256 clock cycles. As soon as a transition occurs at DATAIN, LOS is set to a logic low.
7. Accuracy at room temperature. Stability over temperature is typically ± 20 ppm.

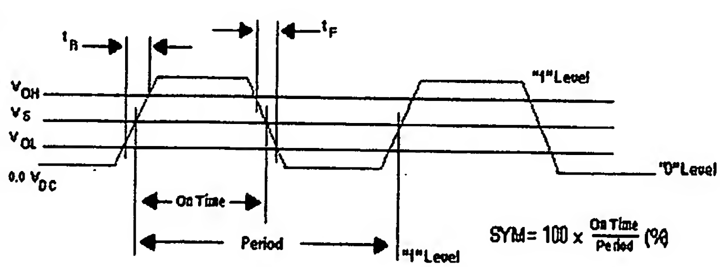


Figure 1.

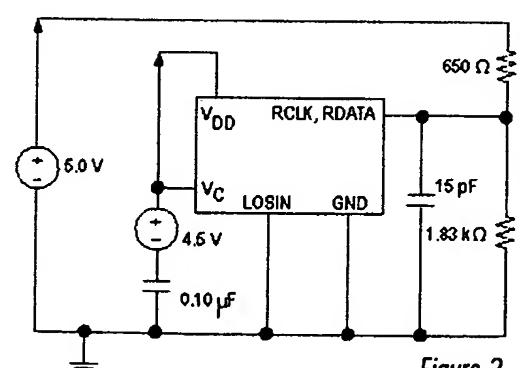


Figure 2.

Vectron International 267 Lowell Road, Hudson, NH 03051 Tel: 1-88-VECTRON-1 e-mail: vectron@vectron.com

RF2703

Absolute Maximum Ratings

Parameter	Rating	Unit
Supply Voltage	-0.5 to 7.0	V_{DC}
IF Input Level	500	mV_{PP}
Operating Ambient Temperature	-40 to +85	°C
Storage Temperature	-40 to +150	°C

Caution! ESD sensitive device.

Parameter	Specification Min.	Specification Typ.	Specification Max.	Unit	Condition
Overall					T=25°C, V_{CC}=3.0V, IF=100MHz, LO=200MHz, F_{MOD}=500kHz
IF Frequency Range		0.1 to 250		MHz	For IF frequencies below ~2.5MHz, the LO should be a square wave. IF frequencies lower than 100kHz are attainable if the LO is a square wave and sufficiently large DC blocking capacitors are used.
Baseband Frequency Range		DC to 50		MHz	
Input Impedance		1200 || 1pF		Ω	Each input, single-ended
LO					
Frequency					Twice (2x) the IF frequency. For IF frequencies below ~2.5MHz, the LO should be a square wave. IF frequencies lower than 100kHz are attainable if the LO is a square wave and sufficiently large DC blocking capacitors are used.
Level		0.06 to 1		V_{PP}	
Input Impedance		500 || 1pF		Ω	
Demodulator Configuration					IF_{IN}=28mV_{PP}, LO=200mV_{PP}, Z_{LOAD}=10kΩ
Output Impedance		50 || 1pF		Ω	Each output, I_{OUT} and Q_{OUT}
Maximum Output		1.4		V_{PP}	Saturated
Voltage Gain		20		dB	V_{CC}=3.0V
	22.5	24	25.1	dB	V_{CC}=5.0V
Noise Figure		24		dB	Single Sideband, IF Input of device reactively matched
		35		dB	Single Sideband, 50Ω shunt resistor at IF Input
Input Third Order Intercept Point (IIP_3)		-22		dBm	V_{CC}=3.0V, IF Input of device reactively matched
		-11		dBm	V_{CC}=3.0V, 50Ω shunt resistor at IF Input
		-19			V_{CC}=5.0V, IF Input of device reactively matched
		-8		dBm	V_{CC}=5.0V, 50Ω shunt resistor at IF Input
		-28		dBm	V_{CC}=5.0V, IF Input of device reactively matched, Z_{LOAD}=50Ω
I/Q Amplitude Balance		0.1	0.5	dB	
Quadrature Phase Error		<±1		°	
DC Output		800		mV	V_{CC}=3.0V, I_{OUT} and Q_{OUT} to GND
	2.0	2.4	2.8	V	V_{CC}=5.0V, I_{OUT} and Q_{OUT} to GND
DC Offset		<10	60	mV	I_{OUT} to Q_{OUT}

Modulator Configuration					IF_{IN}=28mV$_{PP}$, LO=200mV$_{PP}$, Z_{LOAD}=1200Ω
Maximum Output		200		mV$_{PP}$	Saturated
Input Voltage		90		mV$_{PP}$	Single Sideband, 1dB Gain Compression.
Voltage Gain		6		dB	Single Sideband
I/Q Amplitude Balance		0.1		dB	
Quadrature Phase Error		<±1		°	
Carrier Suppression		25		dBc	Unadjusted. Carrier Suppression may be optimized further by adjusting the DC offset level between the A and B inputs.
Sideband Suppression		30		dBc	
Power Supply					
Voltage		2.7 to 6		V	Operating limits
Current		8		mA	V_{CC}=3.0V
	8	10	12	mA	V_{CC}=5.0V

12.1 DC Characteristics: PIC16C54/55/56/57-RC, XT, 10, HS, LP (Commercial)

PIC16C54/55/56/57-RC, XT, 10, HS, LP (Commercial)			Standard Operating Conditions (unless otherwise specified) Operating Temperature 0°C ≤ TA ≤ +70°C for commercial				
Param No.	Symbol	Characteristic/Device	Min	Typ†	Max	Units	Conditions
D001	VDD	**Supply Voltage**					
		PIC16C5X-RC	3.0	—	6.25	V	
		PIC16C5X-XT	3.0	—	6.25	V	
		PIC16C5X-10	4.5	—	5.5	V	
		PIC16C5X-HS	4.5	—	5.5	V	
		PIC16C5X-LP	2.5	—	6.25	V	
D002	VDR	**RAM Data Retention Voltage**(1)		1.5*	—	V	Device in SLEEP Mode
D003	VPOR	**VDD Start Voltage** to ensure Power-on Reset		Vss	—	V	See Section 5.1 for details on Power-on Reset
D004	SVDD	**VDD Rise Rate** to ensure Power-on Reset	0.05*	—	—	V/ms	See Section 5.1 for details on Power-on Reset
D010	IDD	**Supply Current**(2)					
		PIC16C5X-RC(3)	—	1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
		PIC16C5X-XT	—	1.8	3.3	mA	FOSC = 4 MHz, VDD = 5.5V
		PIC16C5X-10	—	4.8	10	mA	FOSC = 10 MHz, VDD = 5.5V
		PIC16C5X-HS	—	4.8	10	mA	FOSC = 10 MHz, VDD = 5.5V
		PIC16C5X-HS	—	9.0	20	mA	FOSC = 20 MHz, VDD = 5.5V
		PIC16C5X-LP	—	15	32	µA	FOSC = 32 kHz, VDD = 3.0V, WDT disabled
D020	IPD	**Power-down Current**(2)	—	4.0	12	µA	VDD = 3.0V, WDT enabled
			—	0.6	9	µA	VDD = 3.0V, WDT disabled

* These parameters are characterized but not tested.

† Data in "Typ" column is based on characterization results at 25°C. This data is for design guidance only and is not tested.

Note 1: This is the limit to which VDD can be lowered in SLEEP mode without losing RAM data.

2: The supply current is mainly a function of the operating voltage and frequency. Other factors such as bus loading, oscillator type, bus rate, internal code execution pattern and temperature also have an impact on the current consumption.

a) The test conditions for all IDD measurements in active Operation mode are: OSC1 = external square wave, from rail-to-rail; all I/O pins tristated, pulled to Vss, T0CKI = VDD, $\overline{MCLR}$ = VDD; WDT enabled/disabled as specified.

b) For standby current measurements, the conditions are the same, except that the device is in SLEEP mode. The power-down current in SLEEP mode does not depend on the oscillator type.

3: Does not include current through REXT. The current through the resistor can be estimated by the formula: IR = VDD/2REXT (mA) with REXT in kΩ.

US Patent Number:5,946,343 Issued to Schotz

Item Number 15: DSSS Transmitter, CYLINK SSTX

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 16: DSSS Receiver, CYLINK Part# SPECTRE

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 17: Mixer, IAM81008

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 18: Channel Encoder/Decoder, SRT241203

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 19: Interleaver/De-interleaver, SRT-24INT

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 20: Optical Digital Receiver, HK-3131-01

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 21: Optical Digital Transmitter, HK-3131-03

NO DATASHEET

US Patent Number:5,946,343 Issued to Schotz

Item Number 22: Voltage Controlled Oscillator, M2 D300

NO DATASHEET

EXHIBIT C

NOTE : A=Altstatt S=Schotz FHSS=Frequency Hopping Spread Spectrum w=with Tx=transmitter

System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Tx
A(Tx)	BA1404	3	18-pin 0.44 x 0.30		FM Stereo Transmitter
				16+ hours	Tx continuous operation time
S(Tx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz FHSS Tx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	SAA7360		44-pin 0.50 x 0.50		A/D converter
	>analog	43			function of the A/D converter
	>digital	50			function of the A/D converter
	SAA2520	82	44-pin 0.55 x 0.55		Stereo Filter MPEG
	SAA2521	25	44-pin 0.55 x 0.55		MPEG
	RF2422	45	16-pin 0.39 x 0.24		Modulator
	TQ9132	85	8-pin 0.19 x 0.23		Power Amp
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	HK-3131-01	no data	no data		**Optical Digital Rcvr (*)**
	M2 D300	no data	no data		**VCO (*)**
	SRT241203	no data	no data		**FEC (*)**
	SRT-24INT	no data	no data		**Interleaver (*)**
				0.1 hours or 6+ minutes	

A(Tx) equation in hours:

{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(3mA)]} x (24hour/day) = 16.6 hours

S(Tx w SS) equation in hours:

{(60x50mA-min.)/[(60 min./hrx24 hr/day)(90+1+14+43+50+82+25+45+85+10.2+19mA)]}x(24hr/day)=6.4min

where min = minutes and hr = hours

(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz

NOTE : A=Altstatt S=Schotz FHSS=Frequency Hopping Spread Spectrum w=with Rx=Receiver

System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Rx
A(Rx)	TA7792	4	16-pin 0.77 x 0.30		AM/FM Tuner System
	TA7766A	0.8	18-pin 0.44 x 0.30		FM PLL
				10+ hours	Rx continuous operation time
S(Rx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz FHSS Rx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	MGA86576	16	4-pin 0.20 x 0.07		LNA
	HK-3131-03	no data	no data		**Optical Digital Tx (*)**
	CS8402	1.5	28-pin 1.20 x 0.20		Digital Interface Tx
	SAA2520	82	44-pin 0.55 x 0.55		Stereo Filter MPEG
	TDA1305T	42	28-pin 0.70 x 0.40		DAC
	TRU-050	63	16-pin 0.80 x 0.30		Clock Recovery and Timing
	RF2703	10	14-pin 0.34 x 0.24		Demodulator
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	SRT241203	no data	no data		**FEC (*)**
	SRT-24INT	no data	no data		**De-interleaver (*)**
	IAM81008	no data	no data		**Mixer (*)**
				0.14 hours or 8+ minutes	

A(Rx) equation in hours:

{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(4.8mA)]} x (24hour/day)

S(Rx w SS) equation in hours:

{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)

(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz

NOTE : A=Altstatt S=Schotz DSSS=Direct Sequence Spread Spectrum w=with Tx=transmitter

System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Tx
A(Tx)	BA1404	3	18-pin 0.44 x 0.30		FM Stereo Transmitter
				16+ hours	Tx continuous operation time
S(Tx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz DSSS Tx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	PIC16C55	1.8	28-pin 1.5 x 0.50		Microprocessor
	SAA7360		44-pin 0.50 x 0.50		A/D converter
	>analog	43			function of the A/D converter
	>digital	50			function of the A/D converter
	RF2422	45	16-pin 0.39 x 0.24		Modulator
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	CYLINK SSTS	no data	no data		**DSSS Transmitter (*)**
	HK-3131-01	no data	no data		**Optical Digital Rcvr (*)**
	M2 D300	no data	no data		**VCO (*)**
				0.18 hours or 11 minutes	
A(Tx) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(3mA)]} x (24hour/day)					
S(Tx w SS) equation in hours:					
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)					
(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz					

NOTE : A=Altstatt S=Schotz DSSS=Direct Sequence Spread Spectrum w=with Rx=Receiver

System	Part	SupplyCurrent (in mA)	Size (in inches)	Playtime	Note
					Altstatt's Rx
A(Rx)	TA7792	4	16-pin 0.77 x 0.30		AM/FM Tuner System
	TA7766A	0.8	18-pin 0.44 x 0.30		FM PLL
				10+ hours	Rx continuous operation time
S(Rx w SS)	DSP56002	90	144-pin 0.78 x 0.78		Schotz DSSS Rx
	>PLL	1	N/A		PLL located inside DSP56002
	>ckout	14	N/A		ckout located inside DSP56002
	PIC16C55	1.8	28-pin 1.5 x 0.50		Microprocessor
	CYLINK	no data	no data		DSSS Receiver
	MGA86576	16	4-pin 0.20 x 0.07		LNA
	IAM81008	no data	no data		**Mixer (*)**
	CS8402	1.5	28-pin 1.20 x 0.20		Digital Interface Tx
	TDA1305T	42	28-pin 0.70 x 0.40		DAC
	MC12210	10.2	16-pin 0.39 x 0.24		PLL
	SMV2500	19	12-pin 0.28 x 0.28		VCO
	HK-3131-03	no data	no data		**Optical Digital Tx (*)**
				0.25 hours or 15 minutes	

A(Rx) equation in hours:

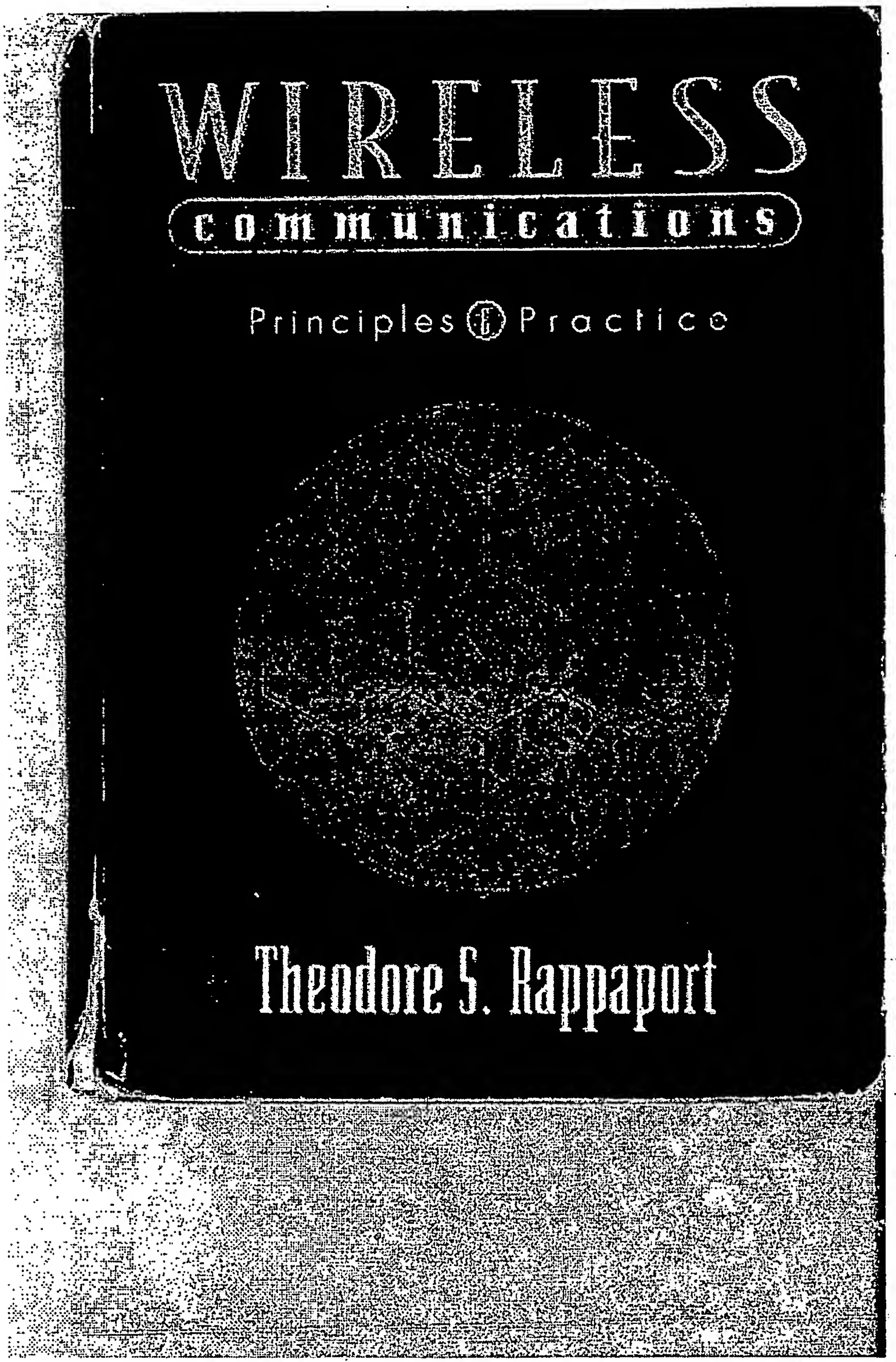
{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(4.8mA)]} x (24hour/day)

S(Rx w SS) equation in hours:

{(60x50mA-minutes)/[(60 minutes/hour x 24 hour/day)(sum of IC currents in mA)]} x (24hour/day)

(*) = Unable to locate datasheet for integrated chip (IC) referenced by Schotz

EXHIBIT D


WIRELESS
communications
Principles & Practice
Theodore S. Rappaport

microcellular systems. However, satellite mobile systems offer tremendous promise for paging, data collection, and emergency communications, as well as for global roaming before IMT-2000 is deployed. In early 1990, the aerospace industry demonstrated the first successful launch of a small satellite on a rocket from a jet aircraft. This launch technique is more than an order of magnitude less expensive than conventional ground-based launches and can be deployed quickly, suggesting that a network of LEOs could be rapidly deployed for wireless communications around the globe. Already, several companies have proposed systems and service concepts for worldwide paging, cellular telephone, and emergency navigation and notification [IEE91].

In emerging nations, where existing telephone service is almost nonexistent, fixed cellular telephone systems are being installed at a rapid rate. This is due to the fact that developing nations are finding it is quicker and more affordable to install cellular telephone systems for fixed home use, rather than install wires in neighborhoods which have not yet received telephone connections to the PSTN.

The world is now in the early stages of a major telecommunications revolution that will provide ubiquitous communication access to citizens, wherever they are [Kuc91], [Goo91], [ITU94]. This new field requires engineers who can design and develop new wireless systems, make meaningful comparisons of competing systems, and understand the engineering trade-offs that must be made in any system. Such understanding can only be achieved by mastering the fundamental technical concepts of wireless personal communications. These concepts are the subject of the remaining chapters of this text.

1.6 Problems

1.1 Why do paging systems need to provide low data rates? How does a low data rate lead to better coverage?

1.2 Qualitatively describe how the power supply requirements differ between mobile and portable cellular phones, as well as the difference between pocket pagers and cordless phones. How does coverage range impact battery life in a mobile radio system?

1.3 In simulcasting paging systems, there usually is one dominant signal arriving at the paging receiver. In most, but not all cases, the dominant signal arrives from the transmitter closest to the paging receiver. Explain how the FM capture effect could help reception of the paging receiver. Could the FM capture effect help cellular radio systems? Explain how.

1.4 Where would walkie-talkies fit in Tables 1.5 and 1.6? Carefully describe the similarities and differences between walkie-talkies and cordless telephones. Why would consumers expect a much higher grade of service for a cordless telephone system?

1.5 Assume a 1 Amp-hour battery is used on a cellular telephone (often called a cellular subscriber unit). Also assume that the phone's radio receiver draws 35 mA on receive and 250 mA during a call. How long would the phone work (i.e. what is the battery life) if the user has one 3-minute call every day? every 6

hours? every hour? What is the maximum talk time available on the cellular phone in this example?

1.6 Assume a CT2 subscriber unit has the same size battery as the phone in Problem 1.5, but the paging receiver draws 5 mA and the transmitter draws 80 mA during a call. Recompute the battery life for the cases in Problem 1.5. Recompute the maximum talk time for the CT2 handset.

1.7 Why would one expect the CT2 handset in Problem 1.6 to have a smaller battery drain during transmission than a cellular telephone?

1.8 Why is FM, rather than AM, used in most mobile radio systems today? List as many reasons as you can think of, and justify your responses. Consider issues such as fidelity, power consumption, and noise.

1.9 List the factors that led to the development of (a) the GSM system for Europe, and (b) the U.S. digital cellular system. How important was it for both efforts to (i) maintain compatibility with existing cellular phones? (ii) obtain spectral efficiency? (iii) obtain new radio spectrum?

1.10 Assume that a GSM, an IS-95, and a U.S. digital cellular base station transmit the same power over the same distance. Which system will provide the best SNR at a mobile receiver? How much is the improvement over the other two systems? Assume a perfect receiver with only thermal noise is used for each of the three systems.

1.11 Discuss the similarities and difference between a conventional cellular radio system and a space-based cellular radio system. What are the advantages and disadvantages of each system? Which system could support a larger number of users for a given frequency allocation? How would this impact the cost of service for each subscriber?

1.12 Assume that wireless communication services can be classified as belonging to one of the following four groups:

High power, wide area systems (cellular)
Low power, local area systems (cordless telephone and PCS)
Low speed, wide area systems (mobile data)
High speed, local area systems (wireless LANs)

Classify each of the wireless systems described in Chapter 1 using these four groups. Justify your answers. Note that some systems may fit into more than one group.

1.13 Discuss the importance of regional and international standards organizations such as ITU-R, ETSI, and WARC. What competitive advantages are there in using different wireless standards in different parts of the world? What disadvantages arise when different standards and different frequencies are used in different parts of the world?

1.14 Based on the proliferation of wireless standards throughout the world, discuss how likely it is for IMT-2000 to be adopted. Provide a detailed explanation, along with probable scenarios of services, spectrum allocations, and cost.

Solutions Manual to Accompany

Wireless Communications Principles and Practices

FIRST EDITION

Zhigang Rong

Theodore S. Rappaport

Prentice Hall PTR
Upper Saddle River, New Jersey 07458

Cont'd

infrastructure, complexity, hardware cost are all low.

A cordless telephone, on the ther hand, is a full duplex system. It allows simul-neous two-way communication. Transmission and reception s on two different channels (FDD) although new cord-ess system are using TDD. The coverage range, required ifrastructure, hardware cost of a cordless phone system are :w and the complexity is moderate. User expectations are reater for a cordless telephone.

1.5 If the user has one 3-minute call every day

$$\text{the battery life} = \frac{60\times1000 \text{ (mA-minute)}}{(60\times24-3)\times35 + 3\times250 \text{ (mA-minute)}}$$

$$\doteq 1.175 \text{ days} \doteq \underline{\underline{28.2 \text{ hours}}}$$

If the user has one 3-minute call every 6 hours

$$\text{the battery life} = \frac{60\times1000}{(60\times6-3)\times35 + 3\times250} \times 6 \doteq \underline{\underline{27.18 \text{ hours}}}$$

If the user has one 3-minute call every hour.

$$\text{the battery life} = \frac{60\times1000}{(60-3)\times35 + 3\times250} \doteq \underline{\underline{21.86 \text{ hours}}}$$

$$\text{the maximum talk time} = \frac{60\times1000}{250} = 240 \text{ minutes} = \underline{\underline{4 \text{ hours}}}$$

1.6 For 3-minute call/day

$$\text{battery life} = \frac{60\times1000 \text{ (mA-minute)}}{(60\times24-3)\times5 + 3\times80} \doteq 8.08 \text{ days} = \underline{\underline{193.94 \text{ hours}}}$$

1.6 Cont'd

For 3 minute-call/6 hours,

$$\text{battery life} = \frac{60\times1000}{(60\times6-3)\times5+3\times80} \times 6 \doteq \underline{\underline{177.78 \text{ hours}}}$$

For 3 minute-call/hour,

$$\text{battery life} = \frac{60\times1000}{(60-3)\times5+3\times80} \doteq \underline{\underline{114.29 \text{ hours}}}$$

$$\text{The maximum talk time} = \frac{60\times1000}{80} = 750 \text{ minutes} = \underline{\underline{12.5 \text{ hours}}}$$

$\boxed{1.7}$ Since the coverage range of the CT-2 system is lower than that of the cellular radio system, to obtain the same signal-to-noise ratio in the coverage area, a CT-2 handset requires less transmitted power than a cellular telephone, and thus a smaller battery drain.

$\boxed{1.8}$ FM has several advantages over AM. The most important advantage is FM's superior noise suppression characteristics. With Conventional AM, the modulating signal is impressed onto the carrier in the form of amplitude variations. However, noise introduced into the system also produces changes in the amplitude of the envelope. Therefore, the noise cannot be removed from the composite waveform without also removing a portion of the information signal. With FM, the information is impressed onto the carrier in the form of frequency variations. Therefore, with FM receivers,

SPREAD SPECTRUM SYSTEMS WITH COMMERCIAL APPLICATIONS

THIRD EDITION

ROBERT C. DIXON

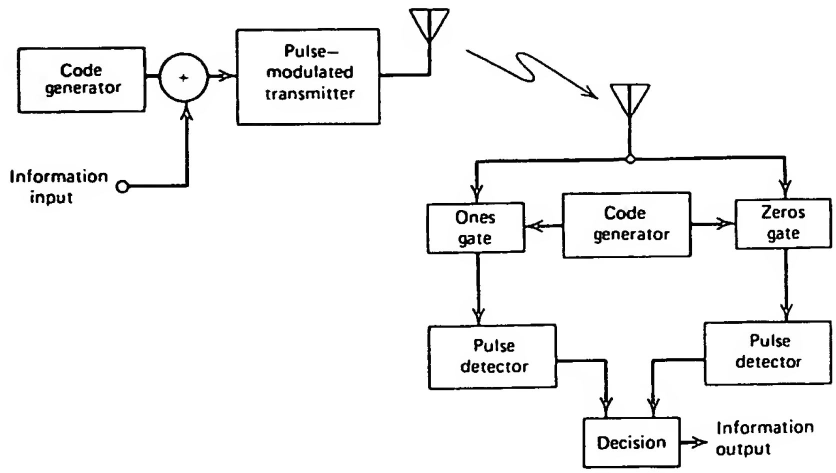


Figure 2.23 Simple time-hopping (pseudorandom pulse) system.

time-frequency hopping system might change frequency and/or amplitude only at one/zero transitions in the code sequence. Figure 2.23 shows a time-hopping system in block form. The simplicity of the modulator is obvious. Any pulse-modulatable signal source capable of following code waveforms is eligible as a time-hopping modulator.

Time hopping may be used to aid in reducing interference between systems in time-division multiplexing. However, stringent timing requirements must be placed on the overall system to ensure minimum overlap between transmitters. Also, as in any other coded communications system, the codes must be considered carefully from the standpoint of their cross-correlation properties.

Simple time-hopping modulation offers little in the way of interference rejection because a continuous carrier at the signal center frequency can block communications effectively. The primary advantage offered is in the reduced duty cycle; that is, to be really effective an interfering transmitter would be forced to transmit continuously (assuming the coding used by the time-hopper is unknown to the interferer). The power required of the reduced-duty-cycle time-hopper would be less than that of the interfering transmitter by a factor equal to the signal duty cycle.

Because of this relative vulnerability to interference, simple time-hopping transmissions should not be used for antijamming unless combined with frequency hopping to prevent single frequency interferers from causing significant losses. For ranging, multiple access, or other special uses time-hopping may be especially useful, if only because of the simplicity of generating the transmitted signal.

Electronic, Electrical and Computer Engineering

UNIVERSITY OF BIRMINGHAM

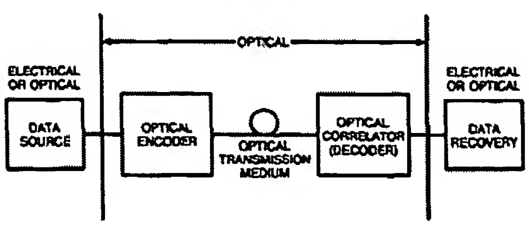
3rd month report

Optical CDMA Networks

M. Massoud Karbassian

1. Introduction

The process of optical to electrical and vice versa conversion in fibre-optic-based optical networks for signal processing limits how much fibre bandwidth can be used because of the limited speed of electronic signal processors. It is believed that optical components, once fully developed and integrated, will offer much higher speeds for optical signal processing than electrical one. Therefore, a desirable feature of optical communications systems would be the ability to perform signal processing functions optically only when desired. Fibre optic CDMA takes advantages of excess bandwidth in single mode fibres to map the low information rate of electrical or optical data into high rate optical pulse sequences followed by a laser beam to obtain random, asynchronous communications access free of network control among many users. (Fig.1)



OCDMA signals would be compared at the receivers to a stored copy of itself (correlation process and characteristic of spread spectrum communications) and to a threshold level at the comparator for the data recovery. (Fig.1)

Figure 1. Fibre optic communications system using optical codec

Actually in such a system, there are *N* transmitters and receivers pairs as users that the set of OCDMA pulse sequences essentially become a set of address codes or signature sequences for the network which is shown in Figure 2.

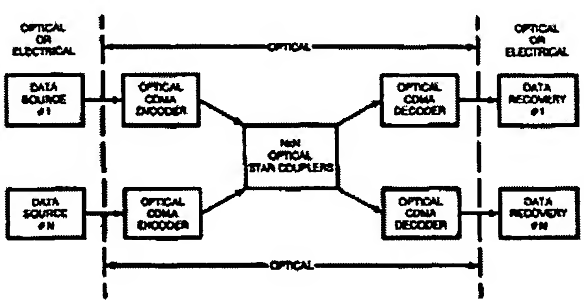


Figure 2. Schematic diagram of an OCDMA communications system

The theoretical available bandwidth in a standard single-mode optical fibre invites us to use it in an advantageous manner to the full usage of such great capacity. For local area networks we can use Time-Division Multiple-Access (TDMA) but we are limited to a few Gbps by the speed of current electro-optic technology and we need an exact synchronization between the

users. Wavelength-Division Multiple-Access (WDMA) would be our next choice but technology again cannot help us avoid the limitations of tuneable optical receivers, which provide us just about an hundred different wavelengths. Although we can combine TDMA and WDMA to get greater speed and flexibility, we really get a great deal of advantage when using Optical Asynchronous Code-Division Multiple-Access (OACDMA) because we eliminate all these problems and others, like channel allocation, channel degradation, security, fixed bit-rate. With all this in mind we can undoubtedly consider OCDMA as a communication system which deserves our attention for present research.

2. Aims and Objectives

Based on the mentioned motivations and because CDMA coding scheme has already been applied into practical radio networks like Mobile Communication (3G) or Global Positioning System (GPS), also deploying CDMA coding in optical channel and making benefit of huge bandwidth with as less as possible *interference* would be the main aims of the project.

There are various types of interferences such as channel noise, thermal noise, users simultaneous access to the network, etc. therefore in order to provide a secure and reliable communication having a clear system performance in an acceptable standard specially dealing with Multi-User Interference (MUI) reduction based on our design or code selection and application would be the main task.

Objectives of the project principally could be pointed as following:

- Grasp CDMA method as multiple access
- Applying CDMA in Optical Communications Networks (OCDMA)
- Introduce novel system feature based on using alternative schemes than previously used
- Improving the system performance:
    - Focused on MUI Suppression
    - Noise Reduction

3. Literature Survey

3.1. Spread Spectrum Communications

Spread spectrum (SS) communications systems have the characteristic attributes that the needed transmission bandwidth is much greater than the baseband message signal bandwidth and that the transmission bandwidth is determined by a spreading signal that is independent of the message. Furthermore, the receiver will recover the signal by applying the same spreading code which was in transmitted signal. The main advantage of such a system is interference rejection both intentional and unintentional one. In addition to interference rejection, spread spectrum system offers secure communication (hard to intercept), multi-user random access and high resolution ranging. So by definition a transmission technique in which a pseudo-noise code independent of the information is employed as a modulation waveform to *'spread'* the signal energy over a bandwidth much greater than the signal information bandwidth then at the receiver the signal *'despread'* using a synchronised replica of the pseudo-noise random code (Fig.3). Two main spread spectrum topologies of all are discussed in the following:

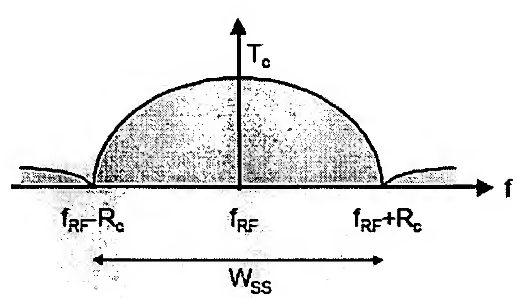


***Figure 3.** Message signal energy spread on bandwidth (DSSS)*

3.1.1. Direct Sequence Spread Spectrum (DSSS)

A pseudo-noise (PN) sequence pn_t generated at the modulator is used in conjunction with an *M-array PSK* modulation to shift the phase of the *PSK* signal pseudo-randomly at the chipping rate R_c $(=1/T_c)$ that is an integer multiple of the symbol rate Rs $(=1/Ts)$ (Fig.4). The transmitted bandwidth is determined by the chip rate and by the baseband filtering. The implementation limits the maximum chip rate R_c (clock rate) and thus the maximum spreading. The *PSK* modulation scheme requires a coherent demodulation. A short-code system uses a PN code

length equal to a data symbol, while a long-code system uses a PN code length that is much longer than a data symbol, so that a different chip pattern is associated with each symbol. (Fig.5)

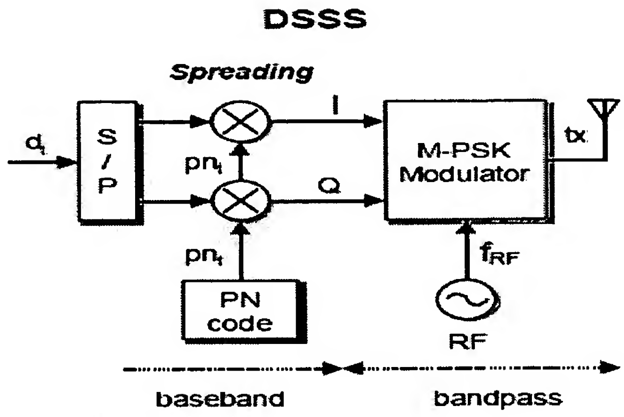


Figure 4. DSSS system concept

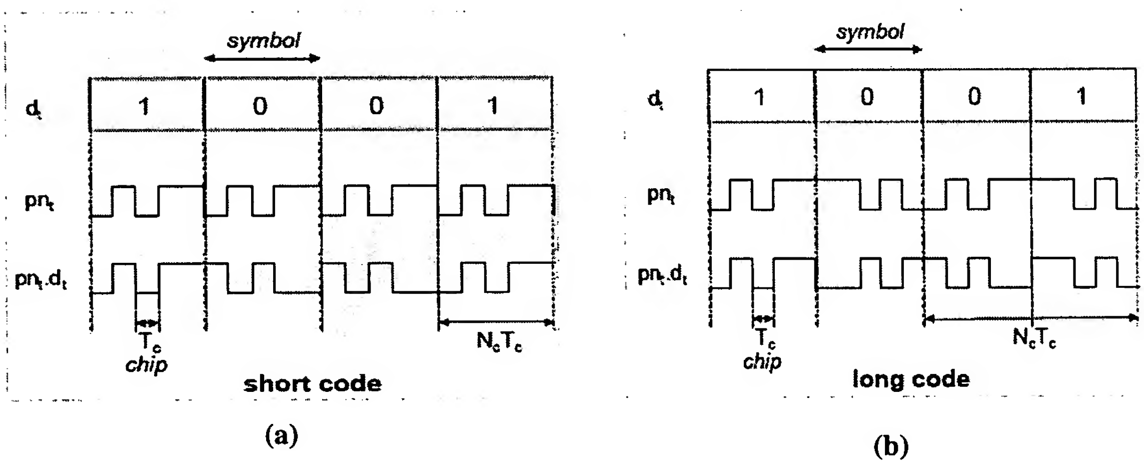


Figure 5. DSSS –a) Short-Code –b) Long-Code systems

3.1.2. Frequency Hopping Spread Spectrum (FHSS)

A pseudo-noise (PN) sequence pn_t generated at the modulator is used in conjunction with an *M-array FSK* modulation to shift the carrier frequency of the *FSK* signal pseudo-randomly, at the hopping rate T_h $(=1/R_h)$ referred to as dwell time. FHSS divides the available bandwidth into N channels and hops between these channels according to PN sequence. At each frequency hop-time the PN generator feeds the frequency synchroniser a frequency word FW (a sequence of n chips) which dictates one of 2^n frequency positions f_{hi}. Transmitter and receiver follow the same frequency hop pattern. (Fig.6)

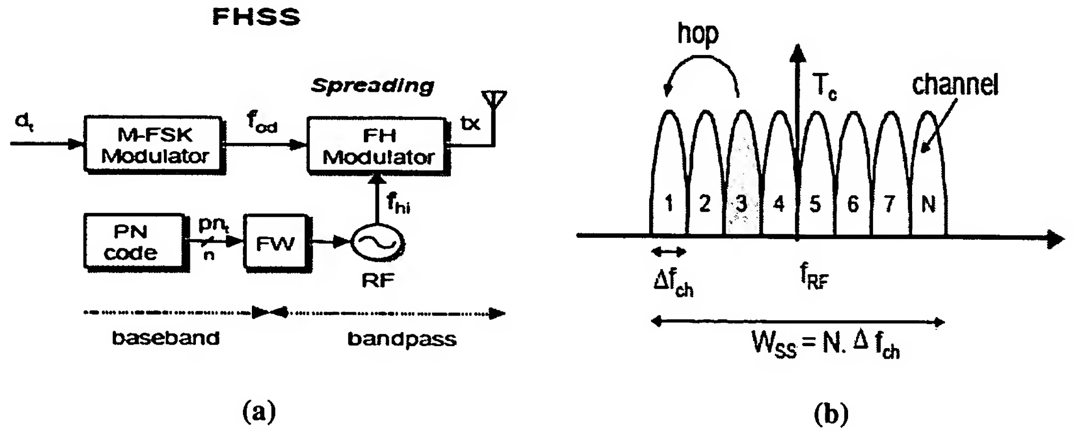


Figure 6. FHSS –a) System concept –b) Frequency hopping during the bandwidth

The transmitted bandwidth is determined by the lowest and highest hop positions and by the bandwidth per hop position (Δf_{ch}). For a given hop, the instantaneous occupied bandwidth is identical to bandwidth of conventional *M-FSK*, which is typically much smaller than W_{ss}. So the FHSS signal is a narrowband signal, all transmission power is concentrated on one channel. Averaged over many hops, the *FH/M-FSK* spectrum occupies the entire spread spectrum bandwidth. Because the bandwidth of a FHSS system only depends on the tuning range, it can be hopped over a much wider bandwidth than a DSSS system.

Since the hops generally result in phase-discontinuity (depending on the particular implementation) a non-coherent demodulation is done at the receiver, while with slow hopping there are multiple data symbols per hop and with fast hopping there are multiple hops per data symbol.(Fig.7)

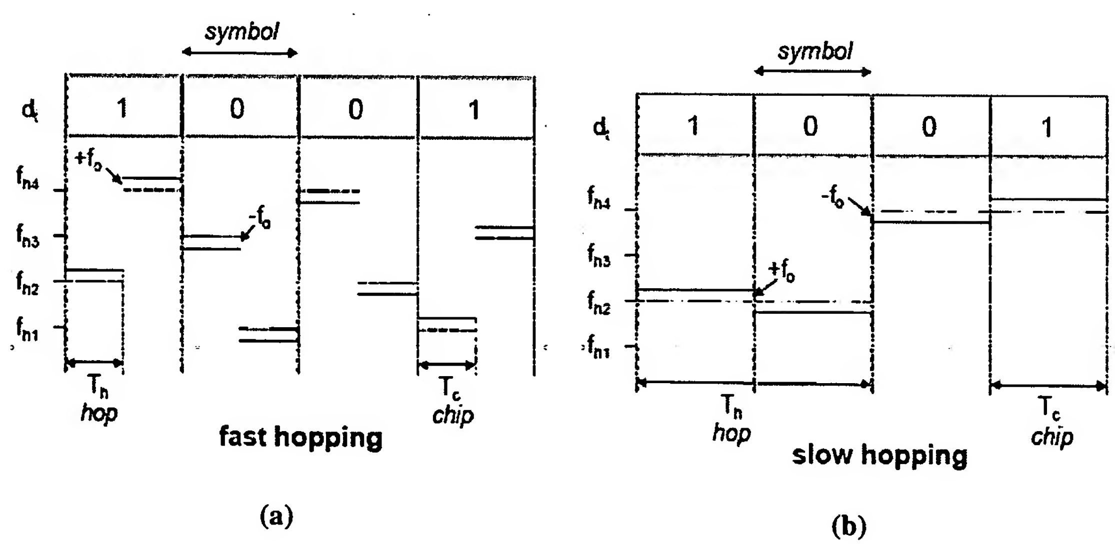


Figure 7. FHSS –a) Fast hopping –b) Slow hopping

3.2. Multiple Access Systems

Code Division Multiple Access (CDMA) is a method of (wirelessly) multiplexing users by distinct (orthogonal) codes. All users can transmit at the same time, and each is allocated the entire available frequency spectrum for transmission. CDMA is also known as spread spectrum multiple access (SSMA). CDMA require neither the bandwidth allocation of FDMA nor the time synchronisation of the individual users needed in TDMA. A CDMA user has full time and full bandwidth available, but the quality of the communication decreases with the number of users (BER increases).

As it can be seen from the Figure 8, each user has its own PN code, uses the same RF bandwidth and transmits simultaneously (synchronous or asynchronous).

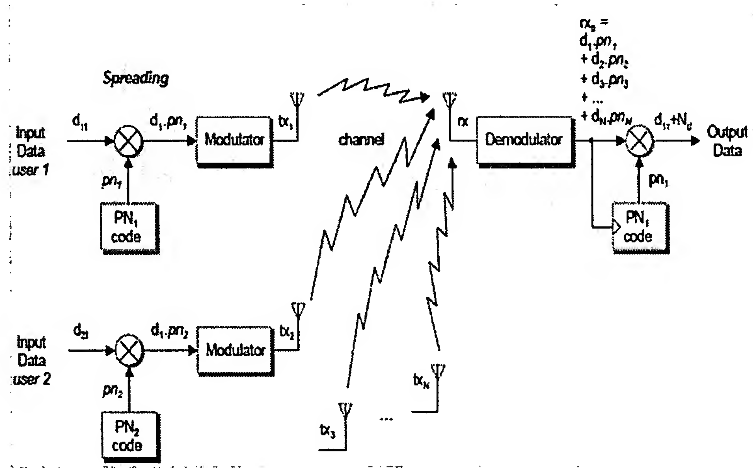


Figure 8. CDMA Network Concept

Correlation of the received baseband spread spectrum signal rx_b with the PN sequence of user1 only despread the signal of user1. The other users produce noise N_u for user1. (Fig.9)

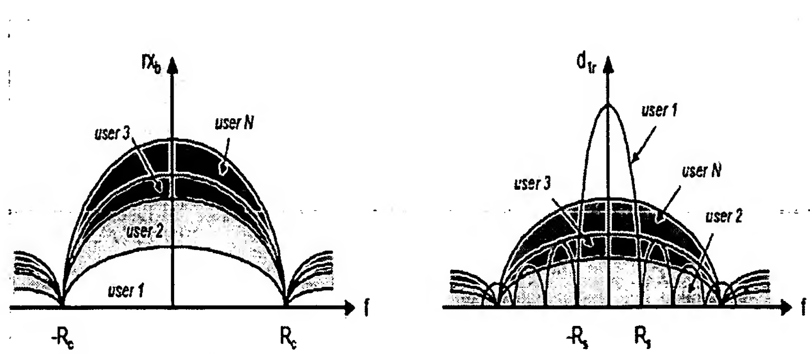


Figure 9. Power distribution on the spectrum and despreading user1

3.3. Codes

In OCDMA systems with incoherent signal processing we are obliged to use signature sequences composed of only zeros and ones. Bi-polar codes used currently on radio networks are infeasible so we need to devise a new kind of codes which satisfy this requirement and the acceptable cross and auto correlation conditions. Optical orthogonal codes (OOC) is a family of unipolar (0,1) sequences characterised by a quadruple (n, ω, λ_a, λ_c) where *n* denotes the sequence length , ω its weight (the number of 1s) then λ_a and λ_c the maximum value of the out-of-phase auto and cross correlation respectively. OOCs are closely related to constant-weight error correcting codes and difference sets.

At the same time we can focus our attention on prime sequences (PC), extended prime sequences (EPC) and their performance improvements against OOC.

Another level of complexity and performance improvement can be achieved when using Turbo Codes (TC) and their performance evaluation on OCDMA systems, since this is a relatively new technology, some new studies of TC applied to OCDMA are worthwhile to study as well.

A field of research is also estimation of interference at the receiver. It has been shown that the system performance increases dramatically when using chip-level detection and/or blind detection. Chip-level detection system performance when using both *PPM* and *OOK* regarding MUI with receiver shot noise, blind detection and interference suppression Avalanche Photo Detector (APD) receivers and interference estimation used to choose an optimum decision threshold level.

4. Task and Time Management

4.1. First Step

Last three months have been successfully dedicated to study the fundamental and very essential materials. As an achievement, I have fully understood:

- Spread Spectrum Communications: focused on two main methods of signal spreading DSSS and FHSS
- Digital Modulations: various signal and pulse modulations, applications and properties
- Source and Channel Coding: different codes and objectives
- CDMA: system concepts and structures as a multiple-access protocol

4.2. Second Step

For next 6 months, I still need a lot more details about CDMA and coding so I have to expand my knowledge in this field especially to implement the software simulation using MATLAB to understand well enough the coding features, modulation and spreading methods altogether. Finally well-developed selections of the methods from each part for the project would be considered. Furthermore, I am going to complete the initial studying of the fundamentals of optical field of research as soon as possible such as:

- Optical Sources and Transmitters
- Optical Fibre as a Channel
- Optical Detectors and Receivers
- Noise in Optical Devices and Systems

Finally at the end of 9 months, I would experiment most of the main concepts of OCDMA and face a new overview. Figure 10 illustrates time and task management progress graphically.

5. Conclusion

To sum up, as tracked in this report the project is in under well control and follows the plan as expected and more importantly a strong foundation of literature has been built. During the few months later, computational and simulation concepts will be implemented and can be realised where the project goes by the hope that a chance of novelty will also be achieved.

ID	Task	Start	Expected Finish Date
1	Project Overview	01/02/2006	28/02/2006
2	Required Analysis	01/02/2006	07/02/2006
3	Study Feasibility	08/02/2006	17/02/2006
4	Project Definition and Scope	15/02/2006	19/02/2006
5	Project Plan	20/02/2006	28/02/2006
6	First Step	01/03/2006	30/04/2006
7	Application Research	01/03/2006	04/03/2006
8	Brainstorming Sessions	03/03/2006	09/03/2006
9	Material Research	04/03/2006	31/03/2006
10	Literature Survey (CDMA, Modulation, Spread Spectrum)	04/03/2006	28/04/2006
11	3rd Month Report	20/04/2006	30/04/2006
12	Second Step	01/05/2006	01/11/2006
13	Material Research	20/04/2006	01/07/2006
14	Literature survey (Optical Comm, CDMA, Code Construction and Algorithms)	20/04/2006	10/10/2006
15	Simulation	01/06/2006	10/10/2006
16	Simulating and Testing Various Concepts	25/06/2006	10/10/2006
17	Conclusion and Decision	10/10/2006	29/10/2006
18	9th Month Report	01/10/2006	29/10/2006

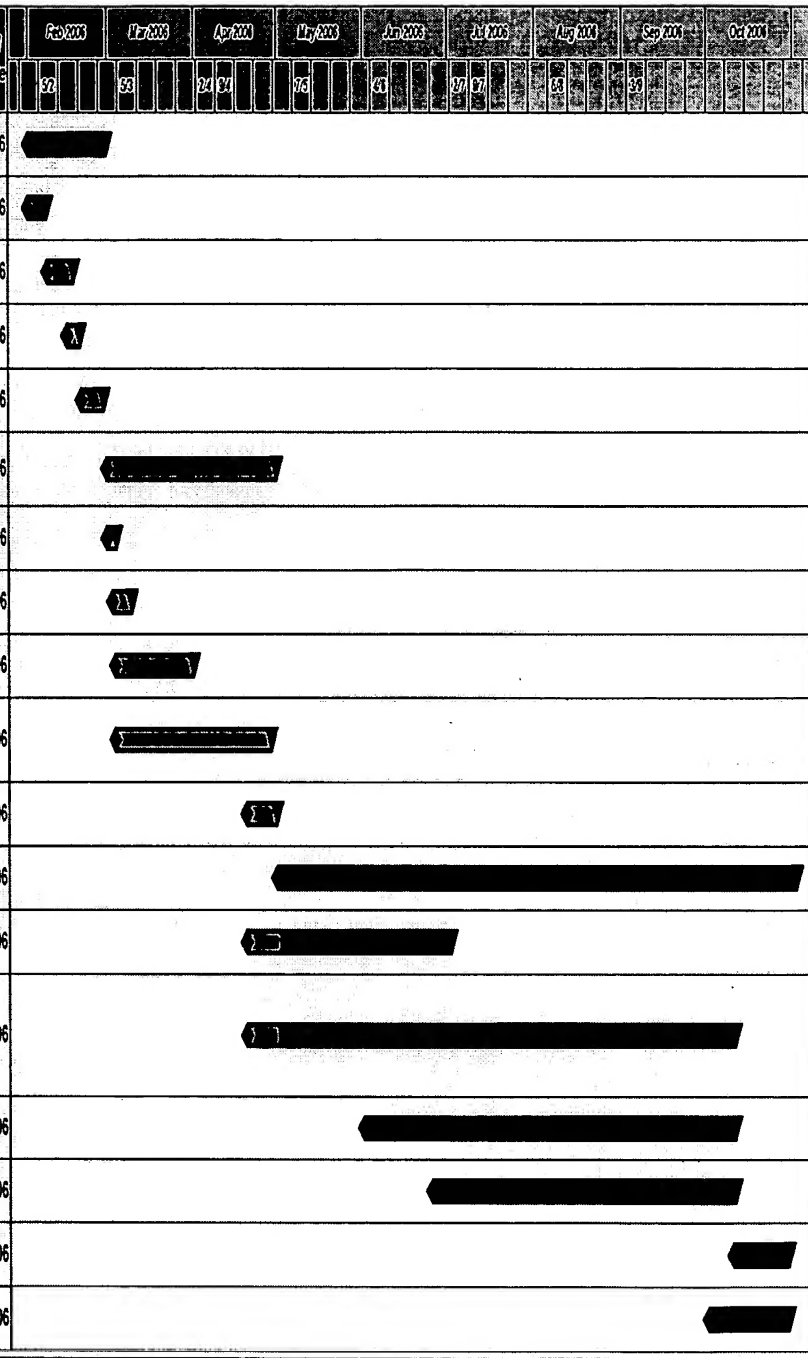


Figure 10. Project Planning

Bibliography

1. John G. Proakis, "*Digital Communications*", McGraw Hill 1995
2. Ir. J. Meel, "*Spread Spectrum – Introduction and Application*", Sirius Communication, 1999
3. R.C.V Macario, "*Personal & Mobile Radio Systems*", Peter Peregrinus Ltd., 1991
4. J.E. Flood, "*Angle Modulation: The Theory of System Assessment*", IEE Telecommunications Series 5, Peter Peregrinus Ltd. 1977
5. Samuel C. Yang, "*CDMA, RF System Engineering*", Artech House Inc. 1998
6. Jerry D. Gibson, "*Principles of Digital & Analog Communications*", Maxwell Macmillan Publishing Company 1993
7. Simon Haykin, "*Communication Systems*", John Wiley & Sons Inc. 1994
8. Martin S. Roden, "*Analog and Digital Communication Systems*", Prentice-Hall Inc. 1996
9. John G. Proakis, Masoud Salehi, "*Communication Systems Engineering*", Prentice-Hall 1994
10. Robert C. Dixon, "*Spread Spectrum Systems with Commercial Applications*", 3rd Edition John Wiley & Sons Inc.1994
11. George R. Cooper and Clare D. McGillem, "*Modern Communications and Spread Spectrum*", McGraw Hill 1986
12. A. P. Clark, "*Principle of Digital Data Transmission*", Pentech press 1983
13. Ramjee Prasad, "*CDMA for Wireless Personal Communications*", Artech House Publisher, 1996
14. Andrew J. Viterbi, "*CDMA, Principles of Spread Spectrum Communication*", Addison Wesley Publishing Company 1995
15. Jawad.A.Salehi, "*Code division multiple-access techniques in optical fibre networks - part I: Fundamental principles*" IEEE Transactions on Communications, vol. 37, pp. 824-833, Aug. 1989.
16. Jawad.A.Salehi and C. A. Brackett,"*Code division multiple-access techniques in optical fibre networks - part II: Systems performance analysis*," IEEE Transactions on Communications, vol. 37, pp. 834-842, Aug. 1989.
17. H. Chung and P. Kumar, "*Optical orthogonal codes - new bounds and an optimal construction*," IEEE Transactions on Information theory, vol. 36, pp. 866-873, July 1990
18. S. V. Maric, "*New family of algebraically designed optical orthogonal codes for use in cdma fiber-optic networks*" Electronics Letters, vol. 29, pp. 538-539, Feb./Mar./Apr. 1993
19. Jawad.A.Salehi, F. R. K. Chung, and V. K. Wei, "*Optical orthogonal codes: Design, analysis, and applications*", IEEE Transactions on Information theory, vol. 35, pp. 595-605, May 1989
20. G.-C. Yang and Wing.C.Kwong, "*Performance analysis of optical cdma with prime codes", Electronics Letters*, vol. 31, pp. 569-570, Mar. 1995